



CONSULTATION PAPER

DEVELOPMENT OF NEW ROYAL NORTH SHORE HOSPITAL ZONE SUBSTATION

30th June 2008

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EXECUTIVE SUMMARY

This paper has been prepared to provide a basis for EnergyAustralia to consult with registered participants and interested parties on the possible options for the development of the electricity supply network in the Royal North Shore Hospital (RNSH) load area (part of Lower North Shore area) to address projected limitations of that part of EnergyAustralia's distribution system.

Section 1 of the paper provides a description of the Lower North Shore load area.

Section 2 presents EnergyAustralia's service standards for the area and describes, in detail, the nature of the forecast load growth in the area, the issues affecting the supply network in the area and the need for augmentation of supply to the area.

Section 3 outlines the possible options to address the issues affecting the supply network including options for supply system development. Two feasible augmentation options are described:

Option 1 – Development of a new 33/11kV RNSH zone substation

Option 2 – Development of a new 132/11kV RNSH zone substation

Section 4 presents the results of a preliminary application of the regulatory test and ranks the options.

Section 5 concludes that the most cost effective strategy within the regulatory test is Option 2 – Development of new 132/11kV RNSH zone substation.

EnergyAustralia's recommended action is the development of new 132/11kV RNSH zone substation and future conversion of Crows Nest and North Sydney zone substations from 33/11kV to 132/11kV operation. The first stage of this option involves reconfiguration of Willoughby STS and development of a new 132/11kV RNSH zone substation and associated 132kV and 11kV feeder works. The estimated capital cost of the first stage is \$54.5M with a net present cost (NPC) of \$47.8M. The total estimated cost for the entire strategy under Option 2 is \$261.7M with a NPC of \$182.4M.

1. INTRODUCTION

1.1. Purpose and Scope

This paper has been prepared to provide a basis for EnergyAustralia to participate with and consult registered participants and interested parties so as to identify possible options to address projected limitations of the electricity supply network in the Royal North Shore Hospital load area (part of Lower North Shore area). It includes:

- A discussion of supply system limitations identified by EnergyAustralia that have led to the necessity of identifying possible options for augmentation of the distribution network in the area;
- A discussion of the service standard that has been adopted for planning purposes;
- A description of possible options which have currently been identified for development of the electricity supply in the area; and
- A detailed preliminary cost effectiveness analysis of each of these options, carried out in accordance with the requirements of the regulatory test.

1.2. Background

The Lower North Shore load area extends from Chatswood and Castle Cove in the north to North Sydney in the south and Mosman in the east. The network in the Lower North Shore area:

- is supplied from TransGrid's transmission system at Sydney East Bulk Supply Point (BSP) via four 132kV feeders via Lindfield switching station;
- includes Castle Cove and Mosman 132/11kV zone substations and Willoughby subtransmission substation (STS), which are supplied at 132kV from Lindfield switching station;
- includes 33/11kV zone substations at Crows Nest, Chatswood, Gore Hill and North Sydney, which are supplied radially at 33kV from Willoughby STS;
- provides a 132kV interconnection at Willoughby STS to Lane Cove switching station to provide backup capacity to cater for double circuit tower or trench outages;
- supplies high rise commercial load in Chatswood and North Sydney;
- predominantly serves residential and commercial load; and
- includes the 33kV supplies to two major customers, the Lane Cove Tunnel and State Rails Authority.

Northern Sydney Area Health has proposed a redevelopment of Royal North Shore Hospital (RNSH) and other associated work in the area with projected additional demand of 10-30MVA (diversified), spread over a period of ten years, starting from 2008. The area at the vicinity of the RNSH is bounded to the north by the Gore Hill Freeway, east by major railway corridors and south by the Pacific Highway.

The existing RNSH load is supplied from Gore Hill zone substation which is forecast to be constrained in summer 2012/13. Although there is spare capacity at Gore Hill zone substation prior to summer 2012/13 to initially supply the load increase, it will exacerbate emerging constraints at Willoughby STS and Gore Hill zone substation. Whilst none of the zone substations except Gore Hill zone supplied by Willoughby STS will exceed their firm capacity in the current forecast period, Willoughby STS will be constrained in summer 2014/15, even without considering future RNSH load.

Figure 1 and 2 indicates the geographic overview of the area and proposed RNSH development respectively.

Lower North Shore Area

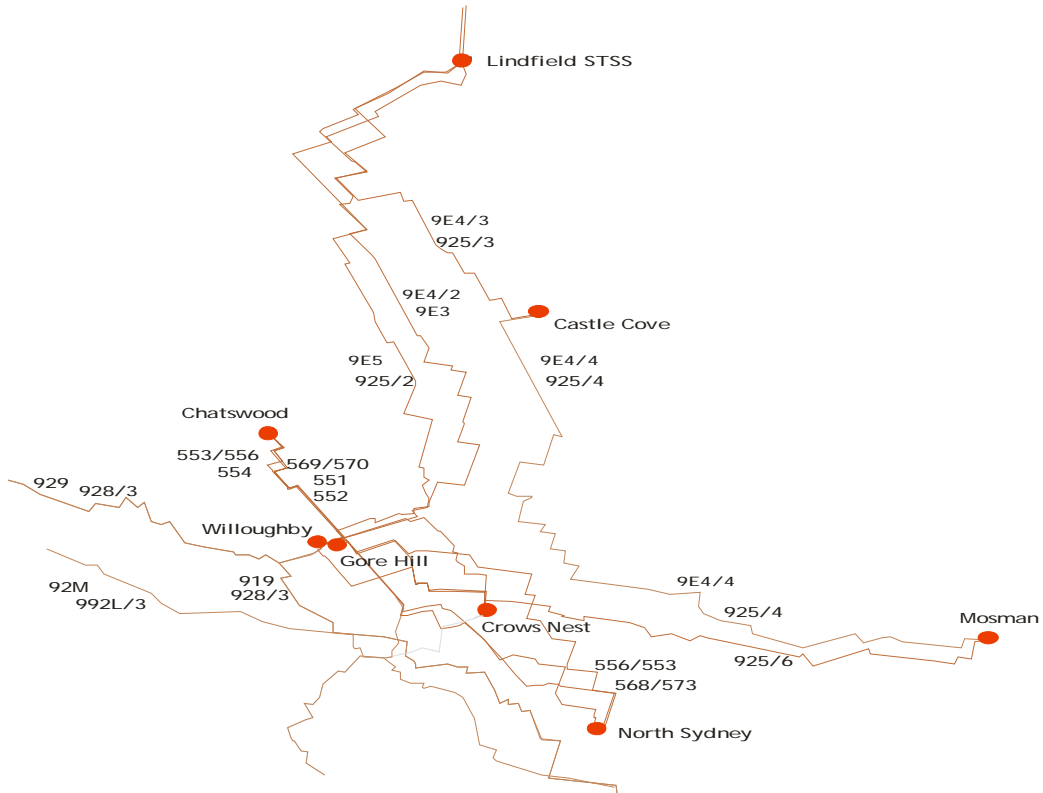


Figure 1 – Geographical Overview of the Area

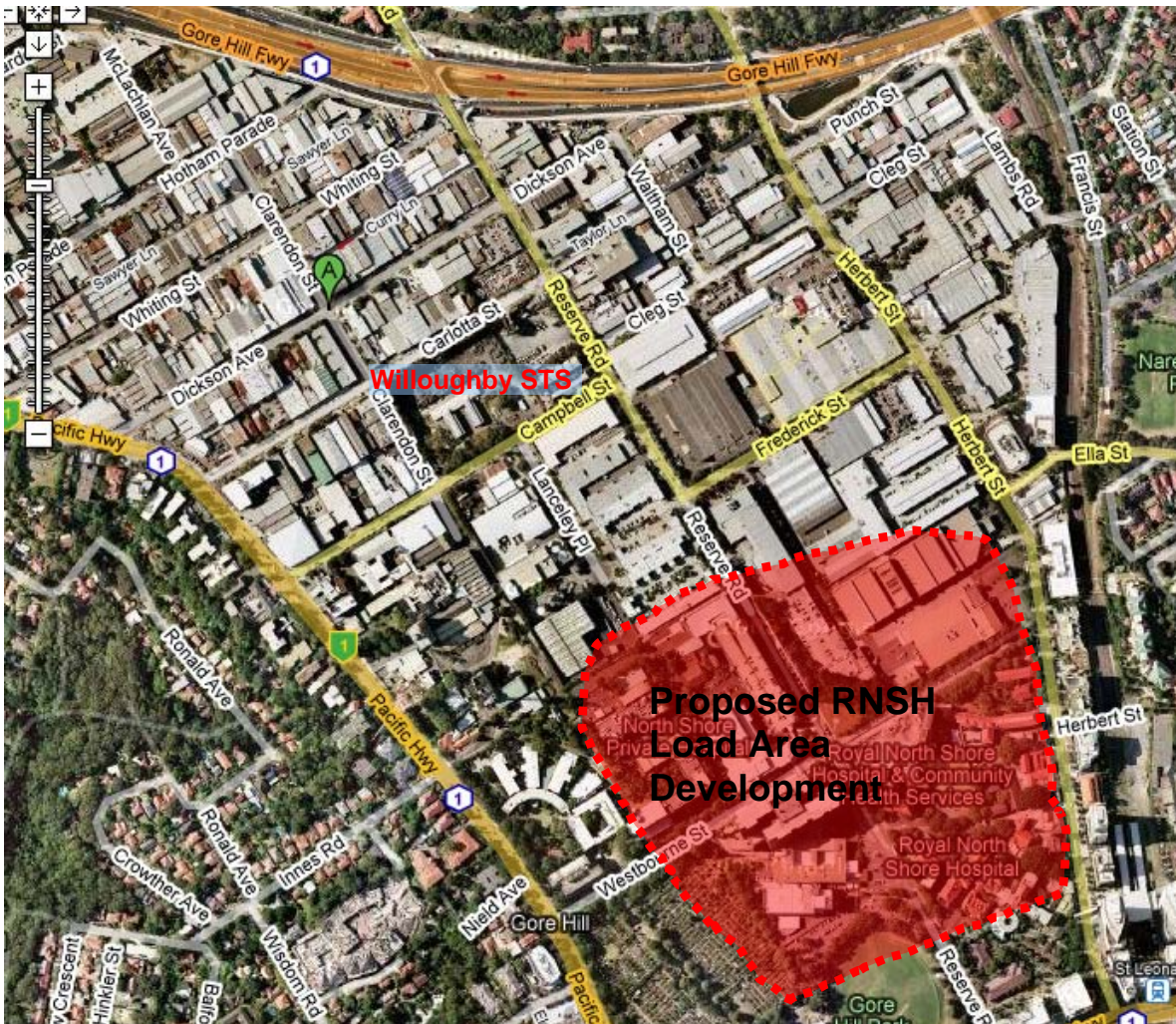


Figure 2 – Proposed RNSH Development

1.3. Supply Arrangements

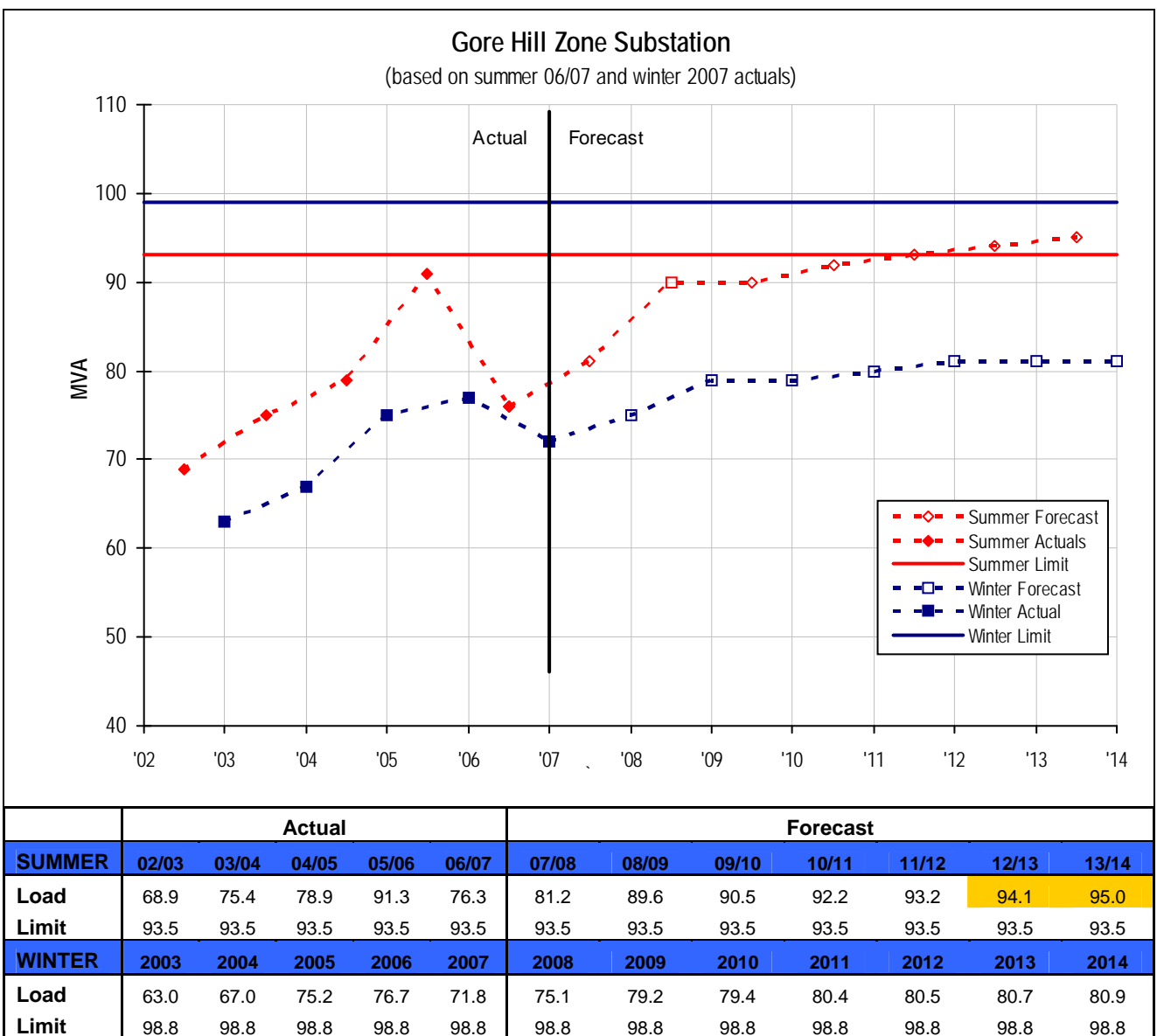
1.3.1. Zone Substations

Supply to the existing Royal North Shore Hospital and its surrounding load area is normally provided by the following zone substations:

Gore Hill Zone Substation

Gore Hill 33/11kV zone substation is 21 years old and is equipped with three 25MVA and one 33MVA 33/11kV transformers and is developed to its ultimate design capacity. The existing RNSH load is supplied from Gore Hill zone substation.

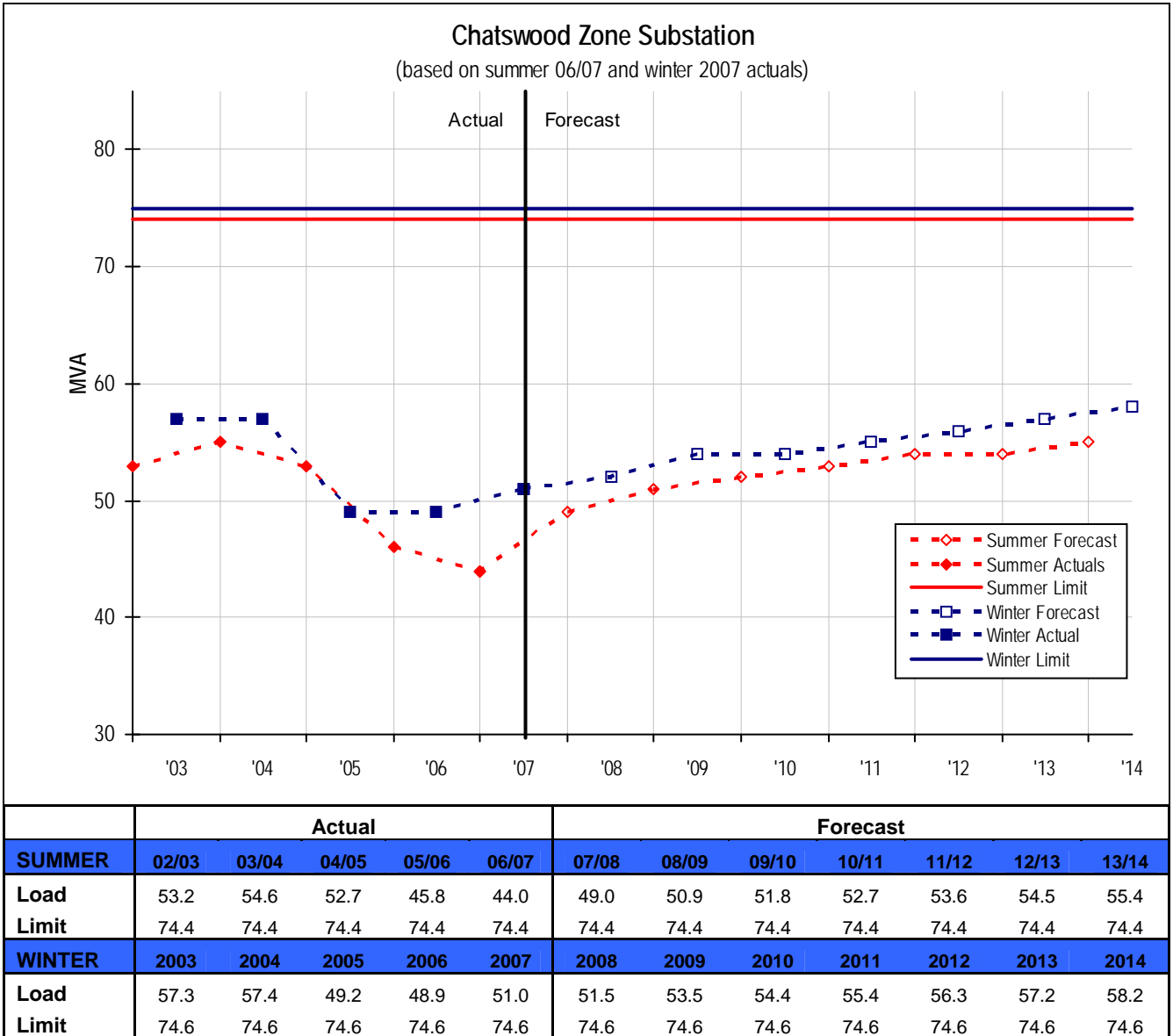
The firm capacity of Gore Hill zone substation is 93.5MVA in summer and 98.8MVA in winter and the peak load was 76.3MVA in summer 2006/07 and 71.8MVA in winter 2007. The zone is forecast to be constrained in summer 2012/13 without considering the future RNSH new development works. This implies that the zone would be constrained significantly earlier than summer 2012/13 if the future RNSH loads are considered.



Chatswood Zone Substation

Chatswood 33/11kV zone substation is 83 years old and has a firm capacity of 74.4MVA in summer and 74.6MVA in winter and is developed to its ultimate design capacity. Chatswood zone substation was recently subject to a comprehensive replacement and refurbishment project, including installation of new zone transformers and 11kV switchgear. This work was completed in 2007. The 33kV feeders from Willoughby STS to Chatswood zone substation are also replaced.

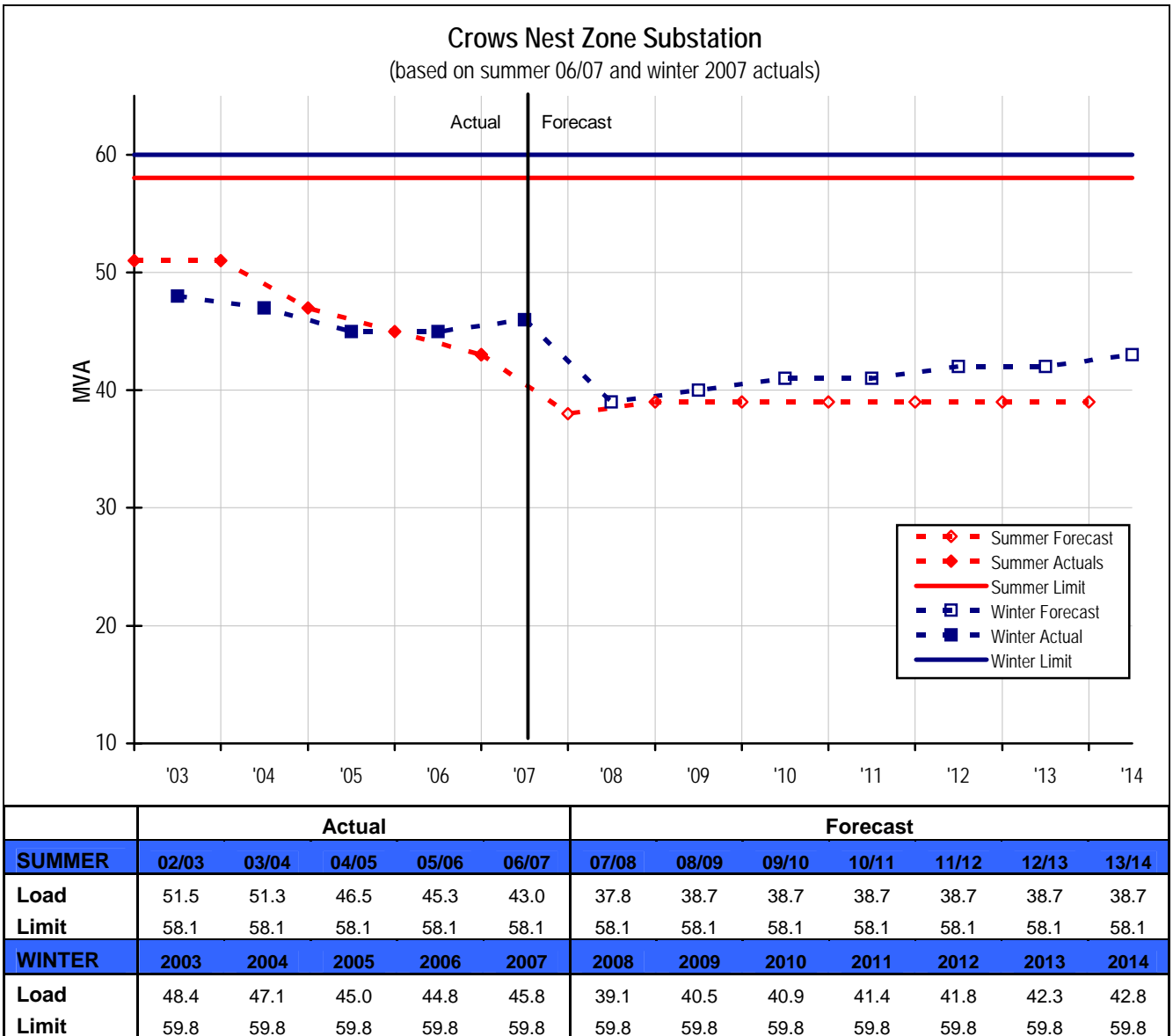
The zone peak load was 44.0MVA in summer 2006/07 and 51.0MVA in winter 2006. The zone is not forecast to be constrained until after 2020.



Crows Nest Zone Substation

Crows Nest 33/11kV zone substation is 76 years old, is equipped with four 19MVA, 33/11kV transformers and is already constructed to its ultimate design capacity. The firm capacity of Crows Nest zone substation is 58.1MVA in summer and 59.8MVA in winter and the peak load was 43.0MVA in summer 2006/07 and 45.8MVA in winter 2007. The zone is not forecast to be constrained until beyond 2020.

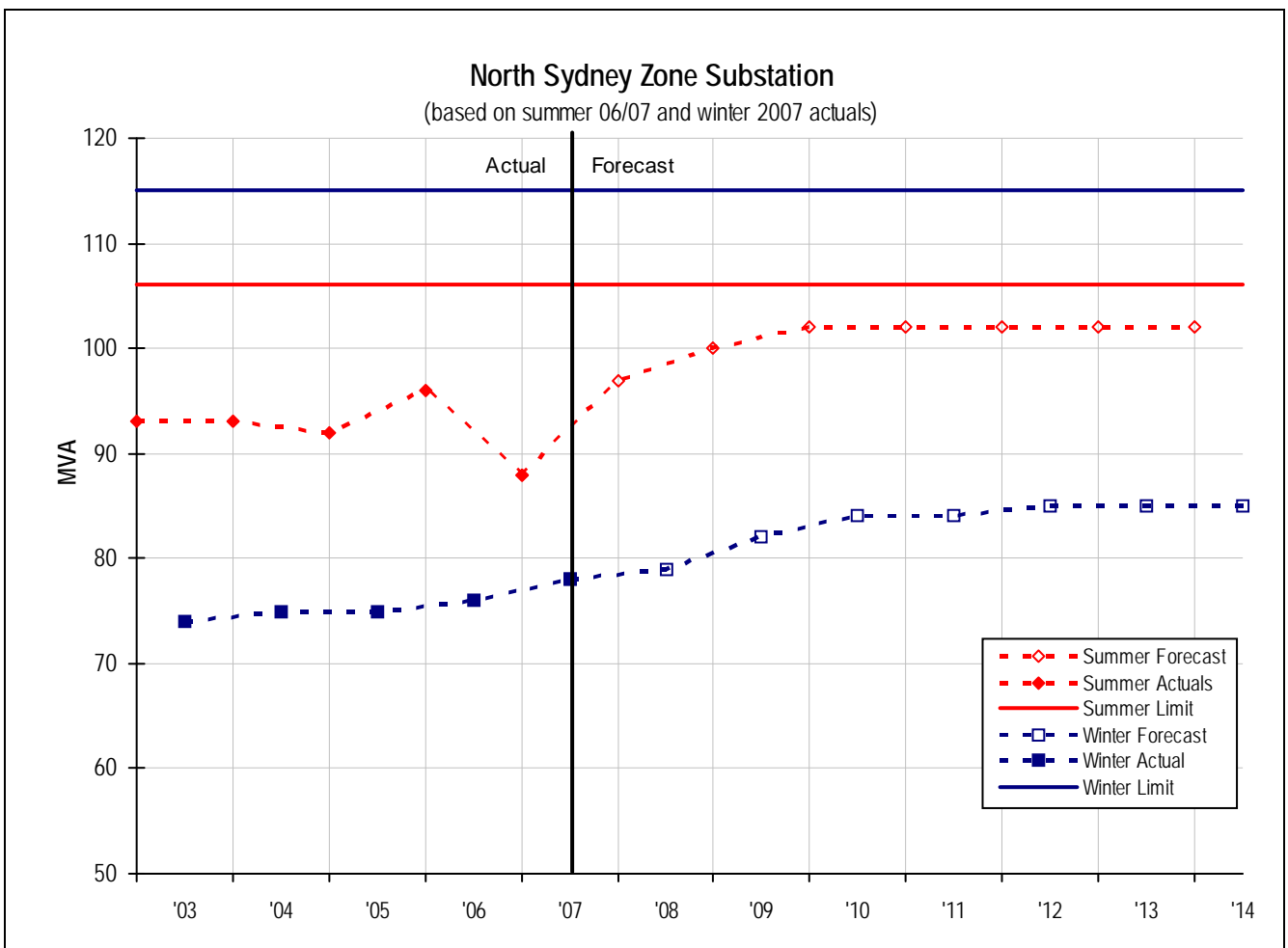
Crows Nest zone substation is supplied from Willoughby STS via four 33kV gas pressure cables which are approaching the end of their useful life and require replacement by 2012. Replacement and refurbishment of 11kV switchgear and the substation control system is currently in progress at Crows Nest zone substation and is scheduled for completion in 2008/09.



North Sydney Zone Substation

North Sydney 33/11kV zone substation is 38 years old. It is equipped with four 33MVA and one 26MVA 33/11kV tail ended transformers and is already constructed to its ultimate design capacity. The firm capacity of North Sydney zone substation is 106.0MVA in summer and 114.8MVA in winter. The substation loading was 88.1MVA in summer 2006/07 and 77.9MVA in winter 2007 and is below the current firm capacity of the zone. The zone is not forecast to be constrained until around 2020.

North Sydney zone substation is supplied from Willoughby STS via five 33kV gas pressure cables which are approaching the end of their useful life. Four out of the five 33kV feeders supplying North Sydney are over 40 years old and are required to be replaced within the next 5-10 years. The 11kV switchgear, together with transformer No.1 are approaching the end of their useful life within the next 5-10 years. The 11kV switchgear replacement will be carried out after the completion of switchgear replacement at Crows Nest zone substation.



	Actual					Forecast							
	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	
SUMMER													
Load	93.1	93.5	92.1	95.5	88.1	97.3	99.5	101.8	101.8	101.8	101.8	101.8	
Limit	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	106.0	
WINTER													
Load	74.5	75.4	74.7	75.6	77.9	79.4	81.8	84.2	84.4	84.6	84.8	84.9	
Limit	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	114.8	

1.3.2. Subtransmission Substations

Supply to Lower North shore area which includes Royal North Shore Hospital loads is normally provided from Willoughby STS.

Willoughby Subtransmission Substation (STS)

Willoughby STS has a firm capacity of 304MVA in both summer and winter limited by transformer capacity. The peak load was 263.4MVA in summer 2006/07 and 247.4MVA in winter 2007 and is forecast to be constrained only in summer 2014/15.

There are number of large future spot loads in this area including additional Royal North shore Hospital and Gore Hill Technology Park. Willoughby STS will not have sufficient capacity to supply these additional loads and will be constrained by summer 2009/10.

Figure 2 below shows the Willoughby STS supply network area.

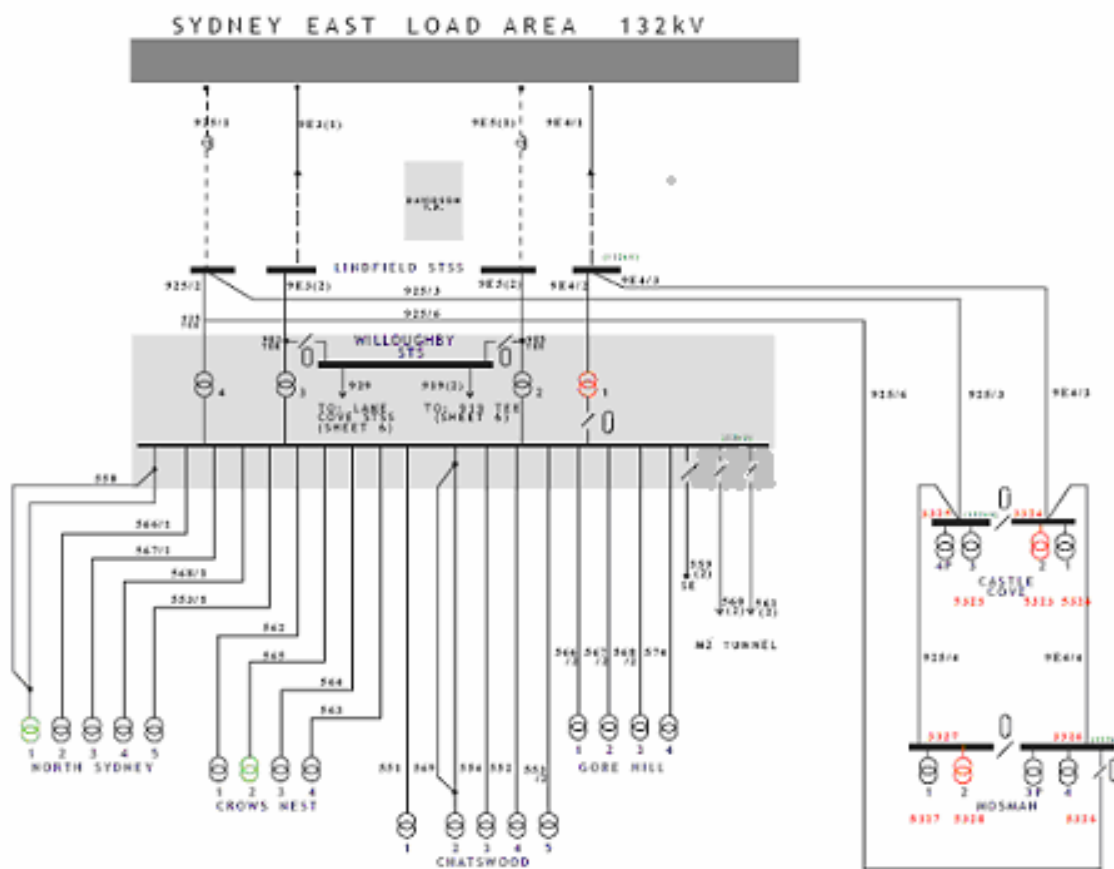
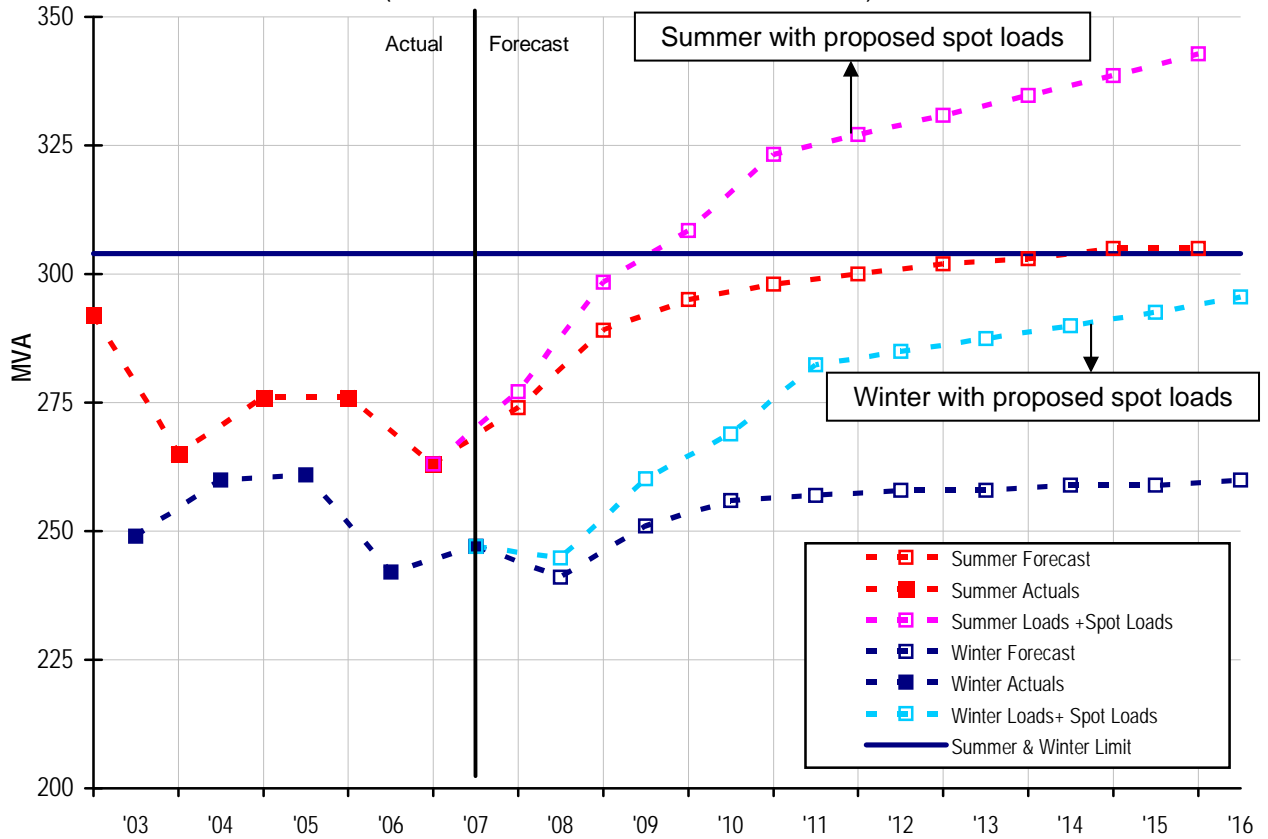


Figure 2 – Willoughby STS Supply Network Area

Willoughby Subtransmission Substation

(based on summer 06/07 and winter 2007 actuals)



	Actual					Forecast									
	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	
SUMMER															
Load	292.5	264.5	276.3	276.3	263.4	273.7	289.3	295.3	298.1	299.9	301.7	303.5	305.3	307.1	
Load+Spot Loads	292.5	264.5	276.3	276.3	263.4	277.1	298.4	308.5	323.3	327.1	330.9	334.7	338.5	342.8	
Limit	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	
WINTER															
2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016		
Load	249.5	259.8	260.8	242.3	247.4	241.4	251.1	255.7	257.2	257.7	258.2	258.7	259.3	259.8	
Load+Spot Loads	249.5	259.8	260.8	242.3	247.4	244.8	260.2	268.9	282.4	284.9	287.4	289.9	292.5	295.5	
Limit	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	304.0	

2. IDENTIFICATION OF NEED FOR AUGMENTATION

2.1. Applied Service Standard

The service standards, in line with the licence conditions imposed by Minister of Energy, that are applicable to a consideration of supply constraints affecting the Royal North Shore Hospital load area are summarised below.

Applicable to all Network Elements

The minimum requirement for any network element is that, with all elements in service, the thermal capacity is required to meet at least 115% of forecast demand. The requirements described in the following sections are additional to this requirement.

Subtransmission substations

For a failure of a single critical element (i.e. N-1 conditions) within a subtransmission substation, the forecast demand is not to exceed the thermal capacity. Recovery of load should be within one minute.

The upper voltage level on the underground 132kV system is restricted to 1.05 per unit. Marginally higher voltages may be possible in some areas with overhead connection. The lower voltage limit is determined by the requirement during first contingency outages for: Transformers in subtransmission substations to maintain regulation; and voltage levels on the 132kV system should not fall below 90% of their nominal voltage (0.9 pu).

The voltage regulation range of the 33kV system is determined by the requirement for zone transformers: to maintain regulation under normal system conditions; and be less than 4% below their set voltage level (allowing for line drop compensation) during first contingency outages.

Zone substations and Overhead Subtransmission Feeders

For a failure of a single critical element (i.e. N-1 conditions) within zone substations supplying greater than 10MVA of load and for overhead subtransmission network, the forecast demand is not to exceed the thermal capacity for more than 1% of the time i.e. a total aggregate time of 88 hours per annum; up to a maximum of 20% above the thermal capacity. Recovery of load should be within one minute.

Under normal conditions (i.e N conditions), the thermal capacity is required to meet at least 115% of forecast demand.

Underground Subtransmission Feeders

For an underground subtransmission feeder, any overhead section should be designed as if it was a subtransmission overhead feeder, providing the forecast demand does not exceed the thermal capacity of the underground section at any time under N-1 conditions.

11kV distribution network

For a distribution feeder in urban¹ area, the expected demand is to be no more than 80% of feeder thermal capacity (under system normal operating conditions), with switchable interconnection to adjacent feeders to enable restoration following an unplanned failure of a single network element (i.e. N-1 conditions). The 11kV network where in a number of feeders forms an interrelated system, the limits apply to the average loading of the feeders within the one system.

For 11kV networks, voltage drops of up to 5% are regarded as satisfactory. Higher voltage drops are permissible provided that the network connection provided to low voltage customers is within the limits specified in Australian Standard AS2926.

2.2. Description of Network Issues

2.2.1. Capacity limitation

Willoughby Subtransmission Substation

Willoughby 132/33kV STS is 40 years old and is equipped with four 120MVA 132/33kV transformers. It has a firm capacity of 304MVA in both summer and winter limited by transformer capacity. The Willoughby STS is developed to its ultimate capacity and is forecast to be constrained in summer 2014/15 even without considering the future development load of 10-30MVA at Royal North Shore Hospital.

There are three relatively large future spot loads in this area which require supply (not included in the current load forecast) and are as below:

¹ Urban, for EnergyAustralia, means an area where the majority of land is zoned for residential and/or commercial and/or industrial use within a town or city type of area which is contiguous with other similar town or city areas with an aggregated population of at least 5,000 people.

- Development of Royal North Shore Hospital and other associated development in the area in the order of 10-30MVA over a period of 10 years, starting in 2008.
- The projected increase in load associated with the Epping to Chatswood rail link of approximately 20MVA (new and existing loads)
- Gore Hill technology Park of around 7.0MVA by 2010.

Considering the above spot loads, Willoughby STS will not have sufficient capacity to supply these extra loads and is forecast to be constrained by summer 2009/10.

Gore Hill Zone Substation

Gore Hill 33/11kV zone substation supplies the existing RNSH load. The zone is forecast to be constrained in summer 2012/13 without considering the future RNSH new development works. This implies that the zone would be constrained earlier than summer 2012/13 if the future RNSH loads are considered.

2.2.2. Operational Issues

A range of operational issues apply to the Lower North Shore network area.

- The 132kV system comprises of four radial 132kV feeders from Sydney East BSP. The feeders have multiple tee-connections and generally have circuit breakers at their source. Many switching operations, including fault clearance, require de-energisation of feeders at Sydney East BSP, which impacts on supply security at Willoughby STS, Mosman and castle Cove zone substations.
- The 33kV cables supplying three transformers at North Sydney and Gore Hill zone substations are double-banked at Willoughby STS. As two feeders connect to a single circuit breaker, a transformer or feeder outage associated with one substation will affect two substations.
- The 33kV cables to Chatswood, North Sydney and Crows Nest zone substations have multiple cables in a single trench. Although they have been installed in the roadway to minimise the risk of mechanical damage, there is a possibility that this could impact multiple cables to a single zone substation site.
- There is minimal 11kV interconnection, particularly to North Sydney zone substation.

2.2.3. Age and Condition of network asset

Based on condition and age information, following assets condition issues are needed to be addressed in Lower North Shore area:

- Cable sections of 132kV feeders 925(2) and 9E5(2) from Lindfield STSS are oil filled type that have condition issues and are currently being replaced.
- The 33kV switchgear at Willoughby STS is of bulk oil type and requires replacement within the next 10-20 years.
- The 33kV gas pressure cables from Willoughby STS to Crows Nest zone is 40 years old and are required to be replaced by 2012.
- 11kV switchgear and control equipment at Crows Nest zone substation is currently being replaced and anticipated for completion in 2008.
- The 33kV gas pressure cables from Willoughby STS to North Sydney zone are required to be replaced within the next 10-20 years.
- 11kV switchgear and transformer No.1 at North Sydney zone substation are required to be replaced by 2011.

2.3. Consideration of Demand Side Management and Local Generation

The proposed investment is driven by the redevelopment of Royal North Shore Hospital with projected additional demand of 10-30MVA spread over a period of ten years, starting from 2008.

A demand reduction of 4.5MVA before summer 2009/10 and 19.3MVA before summer 2010/11 is required to defer the RNSH project by 1 year and 2 year respectively. In August 2007, DM screening test indicated it might be possible to defer the development of 132/11kV RNSH zone substation using DM alternatives and launched an investigation to identify if this was the case. A review of demand management opportunities is presently in progress.

2.4. National Electricity Rules Requirements

RNSH zone substation and its associated feeders are classified as distribution system assets by the National Electricity Rules (the Rules).

The Rules (Clauses 5.6.2(e) and (f)) requires that, where analysis indicates that any relevant technical limits of a distribution system will be exceeded, that the Distribution Network Service Provider (DNSP) must notify any affected Participants of these limitations and of the expected time for corrective action and consult with affected Participants and interested parties on the possible options to address the projected limitations of the relevant distribution system. The proposed options for the RNSH load area (to address the projected limitations of the system) include new distribution network asset options that involve expenditure in excess of \$10 million. These options are classed as new large network assets and consequently EnergyAustralia has an obligation to consult on these options.

EnergyAustralia has previously provided notification of emerging constraints at Willoughby STS in the AESDR of 2006/07 and ESDR of 2007/08.

Clause 5.6.2(g) of the Rules requires DNSPs to include the economic analysis of possible options in their consultation on options. This paper has been prepared to consult on identified options which satisfy the regulatory test and meet the network performance standards set out in Schedule 5.1 of the Rules and limb (a) of the regulatory test must be applied to determine the option that satisfies the regulatory test. Under limb (a) of the regulatory test, the option that meets the test is the one that minimises the present value of costs compared with a number of alternative options in the majority of reasonable scenarios.

3. OPTIONS

The major options considered are described in the following sections.

3.1. Option 1 – Development of a new 33/11kV RNSH Zone Substation

Development of a 33/11kV RNSH zone substation and associated 33kV feeders is one of the possible options considered for the future supply of the load area. As per the forecast, considering the proposed development of RNSH and Gore Hill Technology park, Willoughby STS would be constrained in summer 2009/10. Hence, Crows Nest zone substation would need to be converted to 132/11kV operation before summer 2009/10 to relieve the constraint on the 33kV network supplied by Willoughby STS.

Due to the short time frame and resource availability, it is not physically practicable to convert the Crows Nest zone to 132/11kV operation by 2009. Hence, Option 1 is not considered as a feasible strategy. However for the comparison purpose this option is further analysed to reiterate that development of 132/11kV RNSH zone substation (option 2) still represents the least cost option.

The proposed new RNSH zone substation will be initially equipped with two and provision for ultimately a three 33MVA 33/11kV transformer substation arrangement with three incoming 33kV feeders from Willoughby STS.

Proposed major projects included in this strategy are:

Year	Action
2009	Disconnection of feeders 919 & 929 from Willoughby subtransmission substation. This project is driven by the requirement to connect 132/11kV Crows Nest zone substation.
2009	New 132kV switchgear on feeders 9E3 & 9E5 at Willoughby STS. This project is driven by the requirement to connect the 132/11kV Cows Nest zone substation.
2009	Upgrade of Crows Nest zone substation from 33kV to 132kV operation: This project is driven by the proposed development of RNSH and Gore Hill Technology Park and condition issues with the 33kV gas pressure cables to Crows Nest. The new 132kV cables will be extended to North Sydney zone substation in 2015.
2010	New Royal North Shore Hospital 33/11kV zone substation: This project is driven by the development of the RNSH site.
2011	Replacement of 11kV switchgear at North Sydney zone substation: This project is driven by condition issues. It is proposed to install a new 11kV switchroom adjacent to the North Sydney site and retire 3 of the 4 groups of 11kV switchgear at North Sydney zone substation. This switchroom will ultimately be used by the new 132/11kV North Sydney substation.
2014	New 132kV switchgear on feeders 925/1 & 9E4/1 at Willoughby STS. It is proposed to install a 132kV ring main circuit breaker at Willoughby to provide a connection for the Willoughby to Cremorne/Mosman feeders.
2014	New Cremorne Junction 132/11kV zone substation This project is driven by EA's Network Management Plan obligations to manage the security risks associated with four-transformer 132kV substation designs.
2015	Upgrade of North Sydney zone substation from 33kV to 132kV operation: This project is driven by the loading on Willoughby STS due to the proposed development of RNSH and Gore Hill Technology Park and condition issues with the North Sydney 33kV feeders.

Option 1 consists of the following stages:

Stage 1 – Upgrade Crows Nest zone substation from 33/11kV to 132/11kV operation by 2009

Stage 2 – Development of new 33/11kV RNSH zone substation by 2010.

Stage 3 – Development of new 132/11kV Cremorne Junction zone substation by 2014.

Stage 4 – Upgrade North Sydney zone substation from 33/11kV to 132/11kV operation by 2015.

This consultation paper covers the Stage 2 part of the work only and Stage 1, 3 & 4 works will be

covered under separate consultation paper.

The estimated capital cost for Stage 2 – Development of 33/11kV RNSH zone substation is \$30.2M which includes easement, 11kV and 33kV feeder works. The total estimated capital cost including Stage 1, 2, 3 & 4 is \$255.2M. The Net Present Cost (NPC) is \$186.0M.

3.2. Option 2 – Development of a new 132/11kV RNSH Zone Substation

Option 2 provides for a 132kV development option with two 37.5MVA 132/11kV transformers. The firm capacity of the 132/11kV RNSH zone substation will be 56MVA limited by the emergency rating of the transformers. The supply to the zone substation will require two 132kV feeders from Willoughby STS to new RNSH zone substation. This option will also facilitate the conversion of Crows Nest zone substation to 132/11kV operation and provide load relief for 33kV network supplied by Willoughby STS.

With this option, Willoughby STS will no longer be constrained till beyond 2025

Proposed major projects included in this strategy are:

Year	Action
2010	Disconnection of feeders 919 & 929 from Willoughby subtransmission substation. This project is driven by the requirement to connect 132/11kV RNSH zone substation.
2010	New 132kV switchgear on feeders 9E4 & 9E5 at Willoughby STS. This project is driven by the requirement to connect 132/11kV RNSH zone substation.
2010	New Royal North Shore Hospital 132/11kV zone substation: This project is driven by the development of the RNSH site.
2011	New 132kV switchgear on feeders 9E3 at Willoughby STS. This project is driven by the requirement to connect 132/11kV Crows Nest zone substation.
2011	Upgrade of Crows Nest zone substation from 33kV to 132kV operation: This project is driven by the condition issues with the 33kV gas pressure cables to Crows Nest zone. The new 132kV cables will be extended from Crows Nest to North Sydney zone substation in 2016.
2011	Replacement of 11kV switchgear at North Sydney zone substation: This project is driven by condition issues. It is proposed to install a new 11kV switchroom adjacent to the North Sydney site and retire 3 of the 4 groups of 11kV switchgear at North Sydney zone substation. This switchroom will ultimately be used by the new 132/11kV North Sydney substation.
2014	New 132kV switchgear on feeders 925 at Willoughby STS. It is proposed to install a 132kV ring main circuit breaker at Willoughby to provide a connection for the Willoughby to Cremorne/Mosman feeders.
2014	New Cremorne Junction 132/11kV zone substation This project is driven by EA's Network Management Plan obligations to manage the security risks associated with four-transformer 132kV substation designs.
2016	Upgrade of North Sydney zone substation from 33kV to 132kV operation: This project is driven by the condition issues with the 33kV gas pressure cables to North Sydney zone.

Option 2 consists of following stages:

Stage 1 – Development of new 33/11kV RNSH zone substation by 2010.

Stage 2 – Upgrade Crows Nest zone substation from 33/11kV to 132/11kV operation by 2011

Stage 3 – Development of new 132/11kV Cremorne Junction zone substation by 2014.

Stage 4 – Upgrade North Sydney zone substation from 33/11kV to 132/11kV operation by 2016.

This consultation paper covers the Stage 1 part of the work only and Stage 2, 3 & 4 works will be covered under separate consultation paper.

The estimated capital cost for Stage 1 – Development of 132/11kV RNSH zone substation is \$54.5M which includes easement, 132kV and 11kV feeder works and reconfiguration of Willoughby STS. The total estimated capital cost including Stage 1, 2, 3 & 4 is \$261.7M. The Net Present Cost (NPC) is \$182.4M

4. APPLICATION OF THE REGULATORY TEST

A preliminary economic analysis has been carried out for the period 2007/08 to 2019/20. This analysis involves the comparison of options on an economic basis by carrying out NPC analysis for each of the two options.

EnergyAustralia has included a range of issues in comparison of options such as change in discount rates and variations in zone, transmission and feeder costs. In summary, the two options as presented are technically and economically comparable, given due consideration to all capital costs and operating costs that are able to be defined and quantified.

4.1. Base Case Analysis

In terms of increasing cost the options considered are ranked in the following order considering 8.5% discount rate as the base case:

Options	Initial Capital Cost (\$M)	Total Capital** Cost (\$M)	NPC (\$M)
Option 2 – Development of new 132/11kV RNSH zone substation	54.5	261.7	182.4
Option 1 – Development new 33/11kV RNSH zone substation	30.2	255.3	186.0

** Total capital cost includes all the stages in the overall area strategy of which this option is included.

Detailed analysis is provided in Section 7.0 Appendix – A.

The analysis above indicates that under base case conditions, the NPC of Option 2 is the least cost solution irrespective of Option 1 not being a feasible strategy.

4.2. Sensitivity Analysis

The base case and the range over which sensitivity checks were conducted are shown in the following table;

Parameter	Base Case Value	Sensitivity Checks at
Real Discount Rate	8.5%	7% and 10%
<u>Asset Costs</u>		
Zone Cost	100%	75% and 125%
Transmission cost	100%	75% and 125%
132kV or 33kV Feeder Costs	100%	75% and 125%
Load Growth	100%	50% and 150%

The results of sensitivity analysis are provided in the following table:

Sensitivity Factor	NPC (\$m) Option 1	NPC (\$m) Option 2
Base Case 8.5% Discount Rate	186.0	182.4
7% Discount Rate	197.5	195.6
10% Discount rate	175.5	170.5
25% increase in zone cost	208.0	181.0
25% decrease in zone cost	163.9	139.6
25% increase in transmission cost	192.7	163.7
25% decrease in transmission cost	179.2	156.9
25% increase in 132kV or 33kV feeder cost	203.5	176.2
25% decrease in 132kV or 33kV feeder cost	168.4	144.4
50% increase in load growth	186.0	182.4
50% decrease in load growth	186.0	182.4

The results of the sensitivity analysis reiterates that Option 2 – Development of new 132/11kV RNSH zone substation is the least cost option under all sensitivity scenarios.

5. CONCLUSION

Subject to comments received during the consultation period, EnergyAustralia favours construction of Option 2 on the basis that this solution represents the only feasible strategy and also the least cost in line with the Regulatory Test. This option involves construction of a new 132/11kV RNSH zone substation.

The estimated capital cost of this option is \$54.5M which includes commissioning of new 132/11kV RNSH zone substation, associated 132kV feeder cost and reconfiguration of Willoughby STS. The project is scheduled for completion in 2010/11.

6. CONTACT DETAILS


Comments on this consultation paper, including proposals for alternative options must be in the form of written submissions, which may be in hard copy or suitable electronic format and must be provided by 18th August 2008. Proposals or other enquiries should be directed to the contact listed below:

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7. APPENDIX A – ECONOMIC ANALYSIS OF BASE CASE

The estimates are in real dollars based on 2006/07. Year 2008 refers 2007/08.

 Works covered under this consultation paper

Discount Factor

8.5%

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Option 1 - Development of new 33/11kV RNSH North zone substation

Description	NPC (\$m)	Capex (\$m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Conversion of Crows Nest zone to 132/11kV															
Disconnect feeder 919 & 929 from Willoughby STS	2.07	2.16	1.05	1.11	0	0	0	0	0	0	0	0	0	0	0
Willoughby STS feeder 9E3 & 9E5 132kV RMI and feeder works	15.28	15.71	10.21	5.50	0	0	0	0	0	0	0	0	0	0	0
New 132kV feeders from Willoughby to Crows Nest zone	15.27	16.42	3.30	11.48	1.64	0	0	0	0	0	0	0	0	0	0
Conversion of Crows Nest zone from 33/11kV to 132/11kV	15.57	17.16	0	13.75	3.41	0	0	0	0	0	0	0	0	0	0
O & M Cost	1.76		0	0	0	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Total (Stage 1)	49.95	51.45	15	31.84	5.05	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
New 33/11kV RNSH zone															
Construct new RNSH zone at 33/11kV	16.90	19.70	0.95	2.84	13.23	2.69	0	0	0	0	0	0	0	0	0
Three 33kV Feeder Works & Connections from Willoughby STS to RNSH zone	6.67	8.00	0	1.00	4.00	3.00	0	0	0	0	0	0	0	0	0
11kV works + load transfer from Gore Hill zone	1.51	2.00	0.00	0.00	0.50	0.50	0.50	0.50	0	0	0	0	0	0	0
Easement	0.46	0.50	0.00	0.50	0	0	0	0	0	0	0	0	0	0	0
O & M Cost	1.68		0	0	0	0	0.33	0.33	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Total (Stage 2)	27.22	30.20	0.95	4.34	17.73	6.19	0.83	0.83	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Conversion of North Sydney zone to 132/11kV															
Replacement of existing North Sydney zone 11kV switchgear	7.04	8.99	0	0	0.45	8.09	0.45	0	0	0	0	0	0	0	0
New 132kV feeders from Willoughby to North Sydney zone	17.71	31.06	0	0	0	0	0	0	6.21	21.74	3.11	0	0	0	0
Conversion of North Sydney zone from 33/11kV to 132/11kV	24.77	43.41	0	0	0	0	0	0	7.87	32.55	2.99	0	0	0	0
Sale of existing North Sydney zone land	-2.12	-5.21	0	0	0	0	0	0	0	0	0	0	0	-5.21	0
Total (Stage 3)	49.08	78.25	0	0	0.45	8.09	0.45	0.12	14.20	54.41	6.22	0.82	0.82	-4.39	0.82

Description	NPC (\$m)	Capex (\$m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
New Cremorne Junction 132/11kV zone															
Willoughby STS feeder 925/1 132kV RMI and feeder works	4.61	7.70	0	0	0	0	0	0	5.50	2.20	0	0	0	0	0
Willoughby STS feeder 9E4 132kV RMI and feeder works	4.70	7.85	0	0	0	0	0	0	5.60	2.25	0	0	0	0	0
New 132kV feeders from Willoughby STS to Cremorne Junction zone	28.94	47.96	0	0	0	0	0	1.09	36.13	10.74	0	0	0	0	0
New Cremorne Junction 132/11kV zone	19.50	31.82	0	0	0	0	0	4.71	20.40	6.28	0	0	0	0	0
O & M Cost	1.95		0	0	0	0	0	0	0	0	0.88	0.88	0.88	0.88	0.88
Total (Stage 4)	59.70	95.33	0.00	0.00	0.00	0.00	0.44	5.80	67.63	21.47	0.88	0.88	0.88	0.88	0.88
TOTAL	185.95	255.23	15.51	36.18	23.23	14.60	2.04	7.06	82.50	76.55	7.77	2.37	2.37	-2.84	2.37

Option 2 - Development of new 132/11kV RNSH zone substation



Description	NPC (\$m)	Capex (\$m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Disconnect feeder 919 & 929 from Willoughby STS	1.76	2.16	0	0	1.05	1.11	0	0	0	0	0	0	0	0	0
Willoughby STS feeder 9E4 & 9E5 132kV RMI and feeder works	20.37	25.57	0	0	5.18	20.39	0	0	0	0	0	0	0	0	0
New 132/11kV RNSH zone															
Construct new RNSH zone at 132/11kV	16.35	19.17	0.33	3.01	12.76	3.07	0	0	0	0	0	0	0	0	0
Two 132kV Feeder Works & Connections to RNSH zone	4.05	5.10	0	0	0.81	4.29	0	0	0	0	0	0	0	0	0
11kV works + load transfer from Gore Hill zone	1.51	2.00	0.00	0.00	0.50	0.50	0.50	0.50	0	0	0	0	0	0	0
Easement	0.46	0.50	0.00	0.50	0	0	0	0	0	0	0	0	0	0	0
O & M Cost	3.30		0	0	0	0	0.67	0.67	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Total (Stage 1)	47.79	54.51	0.33	3.51	20.30	29.36	1.17	1.17	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Conversion of Crows Nest zone to 132/11kV															
Willoughby STS feeder 9E3 132kV RMI and feeder works	6.49	7.85	0	0	5.10	2.75	0	0	0	0	0	0	0	0	0
New 132kV feeders from Willoughby to Crows Nest zone	12.97	16.42	0	0	3.30	11.48	1.64	0	0	0	0	0	0	0	0
Conversion of Crows Nest zone from 33/11kV to 132/11kV	13.23	17.16	0	0	0	13.75	3.41	0	0	0	0	0	0	0	0
O & M Cost	1.77		0	0	0	0	0.10	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Total (Stage 2)	34.46	41.43	0	0	8.40	27.98	5.15	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Conversion of North Sydney zone to 132/11kV															
Replacement of existing North Sydney zone 11kV switchgear	7.04	8.99	0	0	0.45	8.09	0.45	0	0	0	0	0	0	0	0
New 132kV feeders from Willoughby to North Sydney zone	16.31	31.05	0	0	0	0	0	0	0	6.21	21.74	3.11	0	0	0
Conversion of North Sydney zone from 33/11kV to 132/11kV	22.83	43.41	0	0	0	0	0	0	0	7.87	32.55	2.99	0	0	0
Sale of existing North Sydney zone land	-2.12	-5.21	0	0	0	0	0	0	0	0	0	0	0	-5.21	0
Total (Stage 3)	45.40	78.24	0	0	0.45	8.09	0.45	0.12	0.12	14.20	54.40	6.21	0.82	-4.39	0.82

Description	NPC (\$m)	Capex (\$m)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
New Cremorne Junction 132/11kV zone															
Willoughby STS feeder 925/1 132kV RMI and feeder works	4.61	7.70	0	0	0	0	0	0	5.50	2.20	0	0	0	0	0
New 132kV feeders from Willoughby STS to Cremorne Junction zone	28.94	47.96	0	0	0	0	0	1.09	36.13	10.74	0	0	0	0	0
New Cremorne Junction 132/11kV zone	19.50	31.82	0	0	0	0	0	4.71	20.40	6.28	0	0	0	0	0
O & M Cost	1.73		0	0	0	0	0	0	0	0	0.77	0.77	0.77	0.77	0.77
Total (Stage 4)	54.77	87.48	0.00	0.00	0.00	0.00	0.44	5.80	62.03	19.22	0.77	0.77	0.77	0.77	0.77
TOTAL	182.42	261.65	0.33	3.51	29.15	65.43	7.21	7.50	63.26	34.53	56.29	8.10	2.71	-2.50	2.71